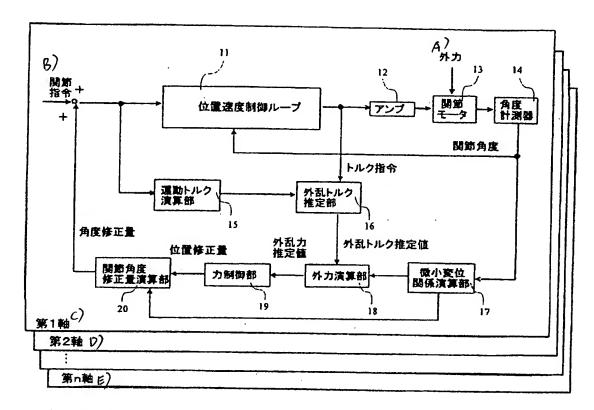
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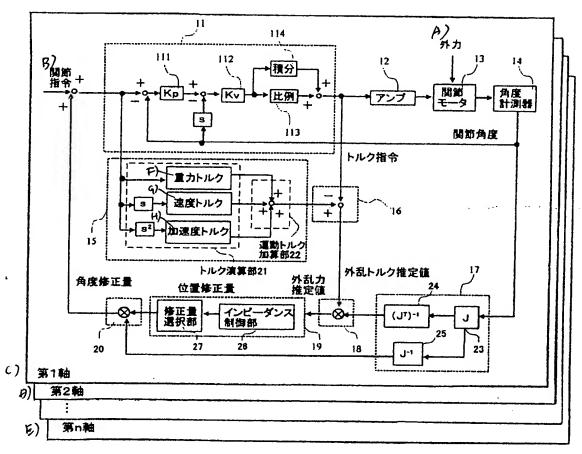
Fig. 1



- A) External Force
- B) Joint Command
- C) First Axis
- D) Second Axis
- E) N-Th Axis
- (11) Position And Speed Control Loop
- (12) Amplifier
- (13) Joint Motor
- (14) Angle Measuring Device
- (15) Motion Torque Calculating Section
- (16) Disturbance Torque Estimating Section
- (17) Minute Displacement Relationship Calculating Section
- (18) External Force Calculating Section
- (19) Force Control Section
- (20) Joint Angle Correction Amount Calculating Section

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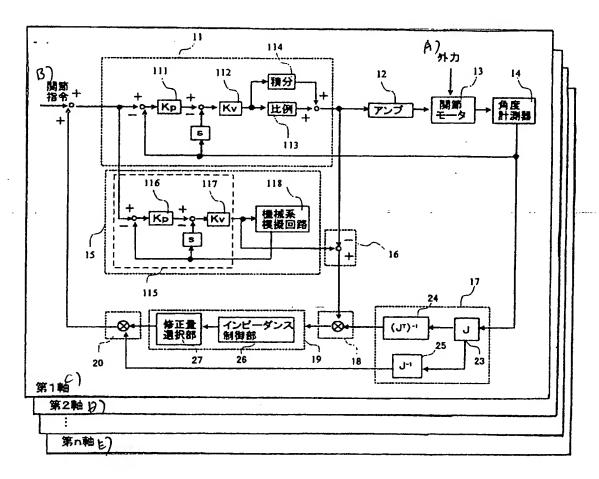
Fig. 2



- A) External Force
- B) Joint Command
- C) First Axis
- D) Second Axis
- E) N-th Axis
- F) Gravity Torque
- G) Speed Torque
- H) Acceleration Torque
 - (12) Amplifier
 - (13) Joint Motor
 - (14) Angle Measuring Device
 - (21) Torque Calculating Section
 - (22) Motion Torque Adding Section
 - (26) Impedance Control Section
 - (27) Correction Amount Selecting Section
 - (113) Proportion
 - (114) Integration

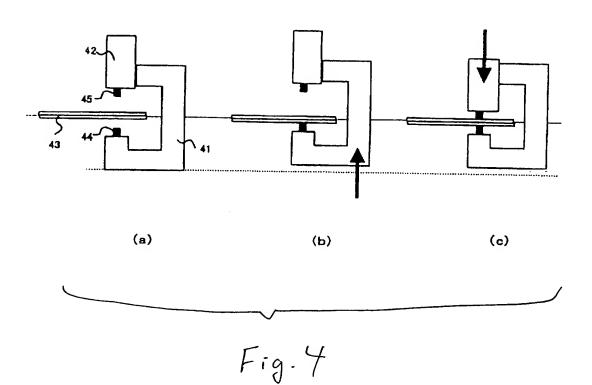
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Fig. 3



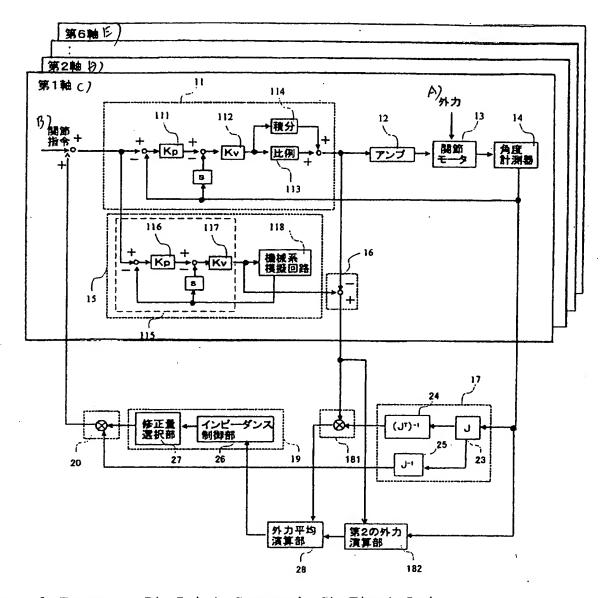
- A) External Force
- B) Torque Command
- C) First Axis
- D) Second Axis
- E) N-Th Axis
- (12) Amplifier
- (13) Joint Motor
- (14) Angle Measuring Device
- (26) Impedance Control Section
- (27) Correction Amount Selecting Section
- (113) Proportion
- (114) Integration
- (118) Mechanical System Imitating Circuit

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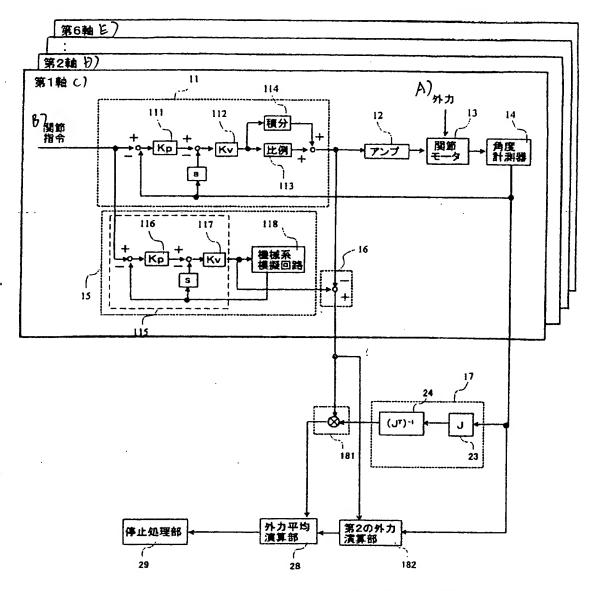
Fig. 5



- A) External Force B) Joint Command C) First Axis D) Second Axis E) Sixth Axis (12)Amplifier (13)Joint Motor (14) Angle Measuring Device Impedance Control Section (26)(27)Correction Amount Selecting Section External Force Average Calculating Section (28)(113)Proportion (114) Integration (118)Mechanical System Imitating Circuit
- (182) Second External Force Calculating Section

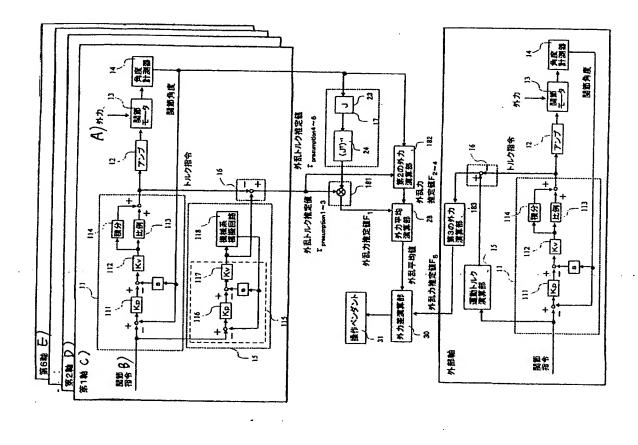
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Fig. 6



- A) External Force
- B) Joint Command C) First Axis
- D) Second Axis
- E) Sixth Axis
- (12) Amplifier
- (13) Joint Motor (14) Angle Measuring Device
- (28) External Force Average Calculating Section
- (29) Stop Processing Section
- (113) Proportion (114) Integration
- (118) Mechanical System Imitating Circuit
- (182) Second External Force Calculating Section

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Second External Force Calculating

Section

(183)

Mechanical System Imitating

Circuit

(182)

Proportion Integration Third External Force Calculating

Motion Torque Calculating Section

Angle Measuring Device

Joint Motor

(13)
(14)

(15)

Amplifier

(12)

Section

(30) External Force Difference Calculating

Section

Operation Pendant

(113) (114) (118)

(31)

Section

External Force Average Calculating

Angle Measuring Device

Joint Motor

Amplifier (13)

(12) (14) (28)

Fig. 7

Joint Command

n n

External Force

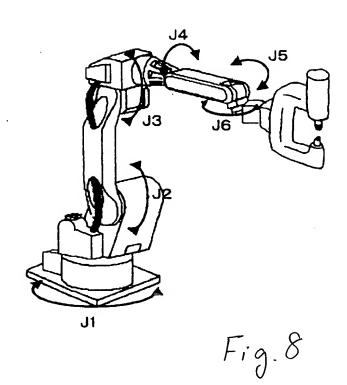
First Axis Sixth Axis

(C)

Second Axis

Ç

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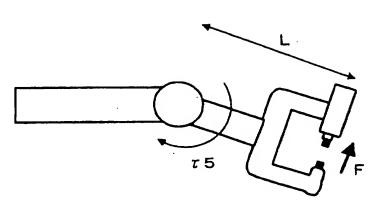


Fig. 9 (a)

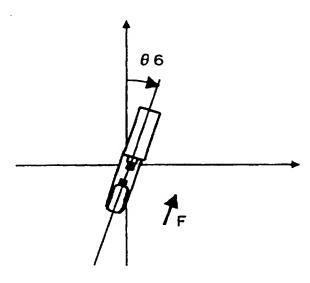
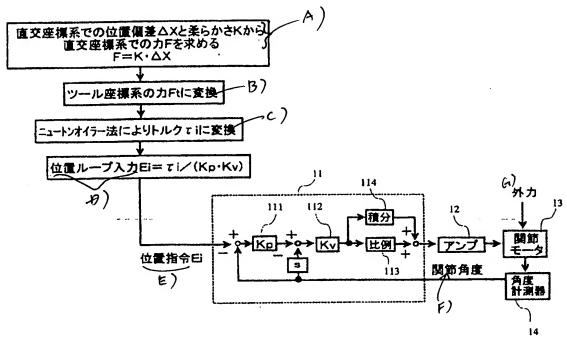


Fig. 9 (b)

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Fig. 10



- A) Obtain force F on Rectangular Coordinate System From Positional Deviation ΔX And Flexibility K
- B) Convert to Force Ft on Tool Coordinate System
- C) Convert to Torque τ 1 by Newton Euler Method
- D) Input A Position Loop
- F) Position Command

F) Joint Angle

G) External Force

- (12) Amplifier
- (13) Joint Motor
- (14) Angle Measuring Device
- (113) Proportion
- (114) Integration